Soft-Tissue Management as Part of the Surgical Treatment of Periimplantitis: A Narrative Review

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Background: *The data on the importance of soft-tissue management during surgical treatment of periimplantitis are still limited, and no clinical recommendations are yet available.*

Aim: *To give an overview on the rationale for periimplant soft-tissue augmentation procedures in the light of potential benefits/risks of the presence/absence of keratinized/attached mucosa (KAM) providing recommendations for the clinician.*

Results: *The available evidence indicates that the presence of KAM favors periimplant tissue health evidenced by improved bleeding scores and facilitation of self-performed plaque removal, less mucosal recessions, and more stable marginal bone levels over time. Therefore, the rationales to augment KAM are (a) to optimize the possibility for performing an adequate level of oral hygiene, (b) to help maintaining periimplant soft-tissue health and stability, and (c) to improve esthetics. Various techniques with autogenous or xenogeneic membranes have been described so far for KAM augmentation. Additional soft-tissue grafting in conjunction with a combined regenerative and resective surgical procedure seems to be effective in treating and controlling advanced periimplantitis lesions and improving or maintaining the esthetic outcomes.*

Conclusions: *The limited available data seem to indicate that the best outcome to improve the width of KAM, and the bleeding and plaque scores, as well as to maintain the periimplant marginal bone level is the use of an apically positioned flap combined with a free gingival graft in nondiseased periimplant sites. However, at present, it is unknown: (a) to what extent soft-tissue grafting may additionally improve the outcomes after surgical (resective or regenerative) treatment of periimplantitis compared with the same approaches without soft-tissue grafting, and (b) if considered, when should soft-tissue grafting be performed (eg, before or during surgical treatment of periimplantitis).*

Clinical Recommendations: *Both soft-tissue resective and regenerative approaches may lead to successful outcomes depending on the clinical indication and defect location. However, the selection of one or another surgical approach should be based on defect type (eg, intrabony and suprabony) and location (esthetic or nonesthetic areas). The presence of an adequate width and thickness of KAM may facilitate soft-tissue (flap) management. In patients with a thin phenotype or lack of an adequate width of KAM, soft-tissue grafting may improve the clinical outcomes. (Implant Dent 2019;28:210–216)*

Key Words: periimplantitis, soft-tissue management, soft-tissue grafting, attached mucosa, resective surgery, regenerative surgery

High long-term survival rates (more than 90%) have been reported for dental implants and implant-supported prosthetic restorations aimed at functional and esthetical rehabilitation.[1–4] Despite successful osseointegration and function over many years, dental implants are susceptible to inflammatory periimplant diseases (ie, mucositis or periimplantitis) affecting the supporting tissues and leading to partial or even total loss of osseointegration.[5] Both mucositis and periimplantitis are defined as inflammatory lesions of the mucosa, which in mucositis is strictly limited to the surrounding mucosa, while in periimplantitis, the mucosal inflammation is associated

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with loss of supporting bone and osseointegration.[5,6] Prevalence rates from a recent systematic review were reported for periimplant mucositis at 43% (range: 19%–65%) and for periimplantitis at 22% (range: 1%–47%).[7]

Bacterial pathogens (ie, periodontal pathogens with a similar composition of the microbiota in chronic periodontitis) represent the primary etiological factor for periimplant diseases.[8,9] In addition, the individual local inflammatory response and the misbalance of the host-parasite interaction are mandatory for the initiation of inflammatory periimplant diseases.[10] Various risk factors have been identified to favor periimplant tissue destruction and play a role in the pathogenesis including history of periodontitis, poor oral hygiene cigarette smoking, diabetes with poor metabolic control, genetic traits, alcohol consumption, and implant surface.[6,11,12] The lack of Keratinized/attached mucosa (KAM) as a possible risk factor for periimplant disease has been also investigated.[12] Nonetheless, an early identification of risk factors, assurance of an optimal self-performed oral hygiene, and therapeutical strategies to minimize the development of periimplant diseases have been suggested to maintain long-term dental implants.[13]

Based on the available evidence for the treatment of established periimplantitis lesions, no specific recommendations with predictable treatment outcomes can be made.[14,15] Since nonsurgical treatment of periimplantitis shows only limited efficacy,[10] the goal of surgical therapy is to improve the cleansability of the implant surface on one side, and on the other side to modify the anatomy of soft and hard periimplant tissues to sustain reosseointegration and long-term maintenance of dental implants.[10]

Conflicting data can be found regarding the influence of the amount of periimplant KAM on periimplant health, and no strong evidence can be found indicating the benefits or risks for its presence or absence.[16–18] However, earlier findings from a preclinical study have demonstrated that the absence of KAM around dental endosseous implants increases the susceptibility of the periimplant region to plaque-induced tissue destruction.[19]

Although some authors have reported on positive effects on periimplant health when KAM was present,[20–22] others sustain that its presence may not influence implant survival.[16] Moreover, patient-centered outcomes have been little investigated in this respect, and this is an issue that has to be considered that pain caused during brushing in situations with limited or no KAM at implants may hamper adequate cleaning and thus represent a risk factor for periimplant inflammation. Analyzing the evidence for performing various types of periodontal plastic procedures to gain KAM or increase its thickness to achieve periimplant health and prevent periimplant diseases, there is a lack in strong evidence and clinical recommendations, and no unanimous consensus exists. Moreover, no clear indications for handling periimplant soft tissues exist.

Considering that there are no clear guidelines for the surgical treatment of periimplantitis and that the soft-tissue anatomy seems to play a major role in the development of periimplant diseases, the aim of the this article was to review the current surgical treatment options to increase KAM at healthy and diseased implants and their efficacy for the prevention and treatment of periimplant diseases.

Role of Keratinized Attached Mucosa in Maintaining Periimplant Tissue Health

It has been generally accepted that assessment of periimplant health is based on the clinical parameters bleeding on probing (BOP) and gingival bleeding indices, probing depths (PDs), and marginal periimplant bone level.[11,23,24] Therefore, changes in the biological periimplant tissues to establish the status of periimplant health are determined using these parameters.[25,26]

The presence and thickness of KAM as related to the health and long-term stability of periimplant tissues have been controversially reported in the literature.[11,18,19,27–36]

On one hand, some clinical studies showed no correlation between the presence of an "adequate" band (ie, ≥2 mm) of KAM and implant stability as assessed by periimplant bone level or probing parameters (ie, PDs).[1,20,28,31,35,37–40] Moreover, results from animal studies sustain the idea that the presence of an "adequate" width of KAM does not significantly influence periimplant tissue conditions.[34]

On the other hand, various clinical studies have suggested that the lack of an adequate width (≤2 mm) of KAM is related to a higher risk of periimplant inflammation and loss of soft and hard tissue.[19,29,36] Some authors reported significant associations between a periimplant KAM width of less than 2 mm and higher bleeding scores,[40–44] higher plaque accumulation,[37–39,41,43,45,46] and more mucosal inflammation[37–39,41,46] compared to sites with adequate KAM width (≥2 mm). Despite these findings, results from a retrospective study reported low incidence rates of periimplant diseases in patients in maintenance therapy irrespective of the width of KAM.[47] The authors suggest that maintaining an optimal level of plaque control is mandatory for assuring periimplant tissue health rather than the presence of an adequate width of KAM.

However, at present, it is generally accepted that the presence of an adequate width of KAM around dental implants is associated with a better soft- and hard-tissue stability[38] and less plaque accumulation, less soft-tissue recession, and lower incidence of periimplant mucositis. Confirming these facts, Roccuzzo et al[48] have evaluated the clinical conditions around dental implants placed in the posterior mandible of healthy or moderately periodontally compromised patients in relation to the presence or absence of KAM. The absence of KAM was associated with higher plaque accumulation, greater soft-tissue recession (REC), and a higher number of sites that required additional surgical and/or antibiotic treatment indicating that implants that are not surrounded by KAM are more prone to plaque accumulation and development of soft-tissue recession despite adequate oral hygiene and supportive periodontal therapy.

On the other hand, findings from a retrospective study failed to reveal an increased incidence of periimplant infections independent of the absence or presence of KAM when the patients

were enrolled in a maintenance program.[47]

However, taken together, most of the available evidence indicates that the lack of an adequate width of KAM around dental implants is associated with more plaque accumulation, inflammation, soft-tissue recession, and attachment loss.[17,42,48–51]

A very recent systematic review has evaluated the effects of soft-tissue augmentation procedures on periimplant health or disease in partially and fully edentulous patients.[22]

The soft-tissue grafting procedures consisted of either increase of keratinized tissue width or an increase of the thickness of the periimplant mucosa. The findings indicated that soft-tissue grafting by means of autogenous grafts may favor periimplant health through gain of KAM, improved bleeding scores, and less marginal bone loss. In the esthetic zone, the use of autogenous connective tissue grafts (CTGs) resulted in an increase in the mucosal thickness around implants and was associated with statistically significantly less marginal bone loss over time. However, the data failed to reveal statistically significant changes in terms of BOP, PDs, or plaque scores at grafted sites compared to sites without grafting. Nonetheless, taken together, based on the available evidence, it is generally accepted that soft-tissue augmentation procedures are beneficial to establish and maintain periimplant health.

Regarding the periimplant mucosal thickness, findings of preclinical and clinical studies suggested a threshold value of 2-mm mucosal thickness for establishing natural periimplant mucosal appearances and minimal soft-tissue discoloration at implant-supported prosthetic reconstructions.[52–55] In addition, adequate mucosal thickness has been shown to decrease the risk of recessions in immediate placement protocols or in specific anatomical situations (ie, minimal or no facial bony wall, orofacial implant malpositions, and various angles of the implant fixtures).[44,56,57]

Despite the fact that several systematic reviews indicate that a periimplant KAM width of less than 2 mm may be correlated with higher plaque levels and periimplant tissue inflammation, soft-tissue recession, and attachment loss,[17,18,21,42,51] there are still insufficient data on the influence and thickness of periimplant KAM and the long-term survival and success rates of dental implants.[58]

According to a recent systematic review, no specific soft-tissue width and thickness can be defined to maintain periimplant health.[59] However, results from a very recent systematic review and meta-analysis indicate that soft-tissue grafting procedures may lead to favorable periimplant health conditions evidenced by improved bleeding indices and higher marginal bone levels.[22]

Taken together, the goal of augmenting periimplant mucosa is to assure long-term tissue stability by optimizing the possibility for performing and maintaining adequate periimplant plaque control in patients with inadequate width (<2 mm) and thickness (<2 mm) of nonmobile mucosa; to facilitate flap handling and wound stability; to support maintaining periimplant soft-tissue health and stability; and to improve esthetics.

PERIIMPLANT SOFT-TISSUE AUGMENTATION PROCEDURES

Periimplant soft-tissue augmentation procedures may be helpful to ensure long-term biological, functional, and esthetic outcomes at osseointegrated dental implants. These may be indicated to gain KAM, to augment soft-tissue volume or to cover recessions.[44,54,60–62] Various surgical techniques combined with autogenous connective or free gingival grafts (FGGs) or with collagen membranes have been investigated for gain in KAM or for thickness augmentation.

Statistically significantly better outcomes for gain in keratinized tissue width, for lower bleeding (BOP, gingival index) and plaque scores, as well as less recession and marginal bone changes were observed in patients treated with the apically positioned flap in conjunction with an FGG as compared to control groups where no grafting was performed.[48,63] When comparing outcomes between the FGG and an acellular dermal matrix (ADM) allograft, statistically significantly greater gain in KAM, less postoperative relapse, lower plaque, and gingival bleeding scores were obtained after 6 months in patients with less than 1.5-mm KAM treated with FGG compared to ADM.[64] However, when a xenogeneic collagen matrix or a CTG was used in subjects with less than 1-mm KAM, no statistically significant differences could be seen after 6 months between the treatment groups with respect to gain in the width of KAM or the esthetic results.[61] An important aspect in these studies is that, with the exception of Basegmez et al who included also sites with mucositis, only healthy implants were treated.[48,61,63]

Regarding the increase of KAM thickness, most studies have investigated the use of subepithelial CTGs at the time of implant placement[65–67] or in the healing phase as compared to control groups with no soft-tissue augmentation procedures.[68–70] Most studies obtained after a minimal follow-up of 1 year significant better outcomes for esthetical indexes, lower recession rates,[65–67,69,70] lower PD values,[65,66,68] and less bone level changes.[66,67] However, Bienz et al reported after 5 years of follow-up only minimal linear and volumetric mucosal changes in subjects where CTG was performed concomitant with guided bone regeneration (test group), and no statistically significant differences were seen between the test and the control group (no CTG augmentation). Augmenting periimplant soft-tissue volume with CTG had no significant influence on bleeding[66,68–70] and plaque scores.[65,66,68–70]

A recent systematic review and meta-analysis that evaluated the effectiveness of periimplant soft-tissue grafting and their effect on periimplant health showed statistically significant outcomes in cases where grafting procedures had been performed for gingival indexes (weighted mean difference [WMD] = 0.86 mm).[22] Moreover, the use of apically positioned flap in conjunction with autogenous grafts as compared to control subjects with no grafting or grafting with collagen matrix led to more stable final marginal bone levels (WMD = −0.175 mm). In this review, the meta-analysis showed that volumetric soft-tissue augmentation procedures with CTG did not statistically significantly affect bleeding

indices; however, significantly less marginal bone loss occurred when augmentation procedures were performed (WMD = 0.110 mm).[22] Based on these results, a recent consensus report recommends soft-tissue augmentation procedures to promote periimplant health.[71]

Taken together, various techniques such as resective, apical repositioned flaps combined with the use of autogenous grafts (FGG and CTG) or xenogenic/allogenic materials have been shown to be successful for nonmobile KAM augmentation. Autogenous materials seem to be superior to other substitute materials.

Soft-Tissue Management in Periimplantitis

Basically, 2 modalities for soft tissue management in conjunction with surgical treatment of periimplantitis have been described in the literature so far: a resective one, more indicated in situations with no esthetical demands,[10,72,73] and a tissue preservation approach when regeneration of the defects is aimed.[10,74–76] The resective approach aims to reduce the periimplant pockets and to enhance the self-performed oral hygiene[77]; with this technique, the collar of the affected tissues is removed, and the flap is repositioned apically.[72] However, it has to be kept in mind that this approach is associated with a substantial apical displacement of the gingival margin and loss of soft tissue. Therefore, this approach is contraindicated for esthetically demanding areas and more suitable for posterior zones.

When regenerative surgery is considered, a recession of the mucosa should be as much as possible avoided to support 3-dimensionally the tissue dimensions and the reosseointegration by means of various types of bone grafts and membranes.[10] Such a technique avoids "per se" any removal of the periimplant mucosa, and various grafts (ie, autologous bone and bone substitutes) combined with resorbable or nonbioresorbable membranes are used to fill/cover the intrabony components.[74,75,78] However, it needs to be pointed out that although the defects were filled and no removal of the inflamed tissue collar was performed, some mucosal recession has still occurred despite the favorable clinical outcomes reported for BOP, PD, and Clinical attachment level (CAL).[75,79,80]

Weak evidence, based on a single case report and a case series, is available on the use of soft-tissue augmentation using either a xenogenic collagen matrix or CTG in conjunction with a combined regenerative and resective surgical treatment of periimplantitis.[81] In those cases, favorable clinical results (BOP, PD, and CAL) have been obtained after treating advanced periimplantitis defects with combined implantoplasty, augmentation of the intrabony defects with a natural bone mineral, and soft-tissue grafting.[81,82]

One case report described the combined surgical therapy of an advanced periimplantitis in a case with thin mucosal tissue.[81] The treatment consisted of access flap surgery, implantoplasty at buccally and supracrestally exposed implant parts, and augmentation of the intrabony component by means of a natural bone mineral and a native collagen membrane after implant surface decontamination. Concomitantly, soft-tissue volume augmentation by means of a collagen matrix was also performed. At 36 months after therapy, the clinical evaluation revealed clinical stability evidenced by substantial reductions in BOP and PD accompanied by limited soft-tissue recessions. Furthermore, a regain in mucosal height and KAM was also noted at 24 months. The authors have suggested the combined surgical procedure as an effective means in treating and controlling periimplantitis defects without compromising the overall esthetic outcomes.

The second report has evaluated the outcomes in 10 patients with a total of 13 implants exhibiting combined suprabony and intrabony defects after treatment using access flap surgery, implantoplasty at buccally and supracrestally exposed implant parts, and augmentation of the intrabony components by means of a natural bone mineral and a native collagen membrane after surface decontamination. In addition, a subepithelial CTG was harvested from the palate and adapted over the wound area to support transmucosal healing.[82] The clinical outcomes at 6 months have shown that the combined surgical procedure was associated with statistically significant improvements in terms of BOP and PD reductions and gains of clinical attachment levels. In addition, a slight increase in mean mucosal height, attributed to the use of CTG, was measured at the buccal aspects.

It has, however, to be pointed out that, on one hand, the clinical outcomes obtained in the aforementioned clinical reports in terms of PD, BOP, and CAL were comparable with those where only bony reconstruction (eg, without soft-tissue grafting) of the periimplantitis defect was performed by means of various types of grafting materials (nanocrystalline hydroxyapatite, natural bone mineral and collagen membrane, algae-derived xenograft, and resorbable synthetic membrane)[75,79,80] or with an open flap debridement, implant decontamination, and use of systemic antibiotics.[83] On the other hand, in the reported studies (eg, without soft-tissue grafting), neither improvements nor an increase in the mucosal recession at the treated defects were observed.

It may thus be anticipated that additional soft-tissue grafting in conjunction with a combined surgical procedure may be effective in treating and controlling advanced periimplantitis lesions by improving or maintaining the esthetic outcomes. However, despite the lack of scientific evidence, the increase of nonmobile KAM width and thickness before periimplant surgical approaches seems reasonable. In addition, clinicians should consider the removal/decrease of muscular activity and frenula pull at affected sites before or during the surgical treatment of periimplantitis to facilitate the surgical approach and clinical outcomes.

Conclusions

The limited available data indicate that the best outcome to improve the width of KAM, and the bleeding and plaque scores, as well as to sustain the periimplant marginal bone level is the use of an apically positioned flap combined with an FGG in nondiseased periimplant sites. However, at present, it is unknown: (a) to what extent

soft-tissue grafting may additionally improve the outcomes after surgical (resective or regenerative) treatment of periimplantitis compared with the same approaches without soft-tissue grafting, and (b) if considered, when should soft-tissue grafting be performed (eg, before or during surgical treatment of periimplantitis).

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The authors claim to have no financial interest, either directly or indirectly, in the products or information listed in the article.

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A. Sculean: manuscript writing and critical evaluation of the literature. G. Romanos: critical evaluation and correction of the manuscript, and discussion. F. Schwarz: critical evaluation and correction of the manuscript, and discussion. A. Ramanauskaite: critical evaluation of the manuscript and critical reading. K. P. Leander: critical evaluation of the manuscript and critical reading. F. Khoury: critical evaluation and correction of the manuscript and discussion. K. T. Koo: discussion and critical reading of the manuscript. R. Cosgarea: manuscript writing and critical evaluation of the literature.

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